

Claims 1-11 are currently pending in the application. Claims 6-11 have been withdrawn from consideration. Applicant hereby confirms the election of Group I, corresponding to claims 1-5, for further prosecution on the merits.

Claim 1 has been amended to explicitly recite that bromide is added subsequent to the formation of the polyamide layer. No new matter has been introduced by this amendment. As one example, support for amended claim 1 may be found at page 9, line 33- page 10, line 1 of the Specification as originally filed.

## II. Rejections under 35 U.S.C. § 102

In one aspect, the Applicant's invention relates to a reverse osmosis membrane containing bromide, wherein the bromide is applied subsequent to the formation of the polyamide skin layer. Advantageously, the Applicant's invention provides an increased salt removal capacity over prior art membranes, which is particularly noticeable with respect to boron and organic compounds such as isopropyl alcohol.

The Examiner rejected claims 1-3 as being anticipated by U.S. Patent No. 4,761,234 (the '234 patent), issued to Uemura *et al.* To the extent that the rejection may apply to the amended claims, the rejection is respectfully traversed. Specifically, the Examiner states that the '234 patent discloses a composite semipermeable membrane containing bromide, as recited in Applicant's claim 1. It is true that the composite membrane of the '234 patent is a polyamide membrane. However, in the '234 patent, bromide is introduced *prior* to the polymerization as a substituent group on an aromatic amine used as a monomer for the production of polyamide. "The substituent include, for instance, . . . halogen such as fluorine, chlorine, bromine . . . ."

'234 patent, col. 3, line 62- col. 4, line 1. Significantly, there is no other disclosure as to the inclusion of bromide in the composite membrane described by the '234 patent.

Because the bromide is introduced as a substituent *prior* to the polymerization, the location of substantially all of the bromide is fixed in the '234 patent. Namely, all of the bromide will be attached as a substituent off of an aromatic ring. The Applicant's invention, however, introduces bromide *subsequent* to the polymerization. Claim 1, as amended, recites "wherein the bromide is introduced subsequent to forming the polyamide skin layer." Support for this amendment is found throughout the Specification.

For example, Example 1 of the Applicant's Specification states that "[i]n the meantime, free chlorine and sodium bromide were dissolved in pure water so as to prepare a free chlorine aqueous solution containing bromine compound. This solution was passed through the composite membrane at an operational pressure of 1.5 Mpa for 30 minutes so that the intended composite reverse osmosis membrane was obtained." Specification, page 9, line 33- page 10, line 1.

The Applicant's Specification further discloses that *in one example*, "the bromine atom substitutes for a hydrogen atom so as to be bound to a carbon atom of the aromatic ring of the aromatic compound." Specification, page 2, lines 27-29. However, it is clear to one of ordinary skill in the art (and may be inferred from the Applicant's use of "for example") that bromide may be included in the polyamide layer in other fashions as well, (e.g., a bromide ion may displace a hydrogen off of a nitrogen atom). The '234 patent only discloses the former instance, while using the methods of the present invention results in both, as well as bromide in

other positions as well. The resulting structural distinction is further illustrated by a comparison of the salt rejection properties of the '234 membrane and the Applicant's membrane.

For example, Example 11 of the '234 patent discloses an isopropyl alcohol (IPA) rejection of 96.8% when a feed solution containing 1000 ppm of IPA is separated under a pressure of 15 kgf/cm<sup>2</sup>. In contrast, Example 1 of the Applicant's invention discloses an IPA rejection of 98% when a feed solution containing 3000 ppm of IPA is separated under a pressure of 15 kgf/cm<sup>2</sup>. In general, if feed solutions containing the same substance at different concentrations are separated under the same pressure conditions, the feed solution containing the substance at a higher concentration is separated at a lower rejection rate. In the examples provided above, the Applicant's membrane provides better performance (as measured by the rejection rate) than the '234 patent, even at a higher concentration.

As amended, claim 1 recites a product by process claim, explicitly disclosing that the bromide is added to a polymer skin layer after the layer has been formed. In addition, it is apparent that because of the order of addition, structural differences exist between the Applicant's claimed invention and the '234 patent.

For the reasons set forth above, withdrawal of the § 102 rejection of claim 1 is respectfully requested. Claims 2 and 3, which depend from claim 1, are likewise patentable.

The Examiner also rejected claim 1 under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 4,778,596 (the '596 patent), issued to Linder *et al.* The Examiner states that the '596 patent discloses a thin film membrane wherein, analogous to the '234 patent, bromine is listed as a possible substituent group that may be used in a monomer. For the same reasons as those described above, this rejection is respectfully traversed. Specifically, the '596 patent

neither shows nor suggests applying bromide subsequent to the formation of a polyamide layer, as recited in amended claim 1.

In light of the above, withdrawal of the § 102 rejection of claim 1 is respectfully requested.

### III. Rejections under 35 U.S.C. § 103

The Examiner rejected claims 4 and 5 under 35 U.S.C. § 103(a) as being unpatentable over the '234 patent. To the extent that the rejection applies to the amended claims, the rejection is respectfully traversed. Specifically, the Examiner states that the '234 patent fails to disclose the membrane as suitable for isopropyl alcohol rejection or boron rejection, and further fails to disclose the operating conditions claimed by the Applicant. However, the Examiner states that "it would have been obvious to one skilled in the art at the time the invention was made to adjust membrane porosity, thickness, amine composition, etc. . . ." because the '234 patent discloses a reverse osmosis membrane having a high water flux and salt rejection. The Applicant respectfully disagrees with the Examiner's unsupported statement as to what is known in the art, and would ask that the Examiner cite to prior art showing the rejection of isopropyl alcohol and boron, or, in the alternative, provide an affidavit of personal knowledge pursuant to 37 C.F.R. § 1.104 (d)(2) describing the modification of membranes suitable for the removal of non-ionic compounds.

Specifically, the Applicant refers to page 1, line 23 to page 2, line 2 of the present Specification, which discusses that conventional composite osmosis membranes do not have sufficient rejection properties for non-ionic compounds such as isopropyl alcohol and boron. The difficulty with these types of compounds is highlighted by comparing Example 5 and

Comparative Example 2 of the present invention. Both of the membranes of Example 5 and Comparative Example 2 have a rejection of 99.7% for salt. However, the membrane of Comparative Example 2 has a rejection of 84% for boron, while the membrane of Example 5 has a rejection of 92% for boron.

Consequently, because of the difficulties in removing non-ionic compounds, the Applicant respectfully asserts that merely modifying the membrane of the '234 patent would not result in the Applicant's invention. As a result, withdrawal of the § 103 rejection of claims 4 and 5 is respectfully requested. In addition, claims 4 and 5 depend from claim 1 and are patentable over the '234 patent for the reasons discussed above.

#### IV. Conclusion

Claims 1-5 have been shown to be allowable over the prior art. Applicant believes that this paper is responsive to each and every ground of rejection cited by the Examiner in the Action dated April 11, 2001, and respectfully requests favorable action in the form of a Notice of Allowance.

Please apply any charges not covered, or any credits, to Deposit Account 50-0591 (Reference No. 04558.044001).

Respectfully submitted,

Date: 9/11/01

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**APPENDIX A – MARKED-UP VERSION OF THE AMENDED CLAIMS**

1. A composite reverse osmosis membrane comprising a porous support and a polyamide skin layer formed on the porous support, wherein the polyamide skin layer is formed by reacting an aromatic compound having at least two reactive amino groups with a polyfunctional acid halide compound having at least two acid halide reactive groups, and the polyamide skin layer contains bromide, wherein the bromide is introduced subsequent to forming the polyamide skin layer.

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